

ABSTRACT

Methods of manufacturing semiconductor devices are disclosed. In a disclosed example, a multi-layered insulating structure is deposited on a semiconductor substrate, an opening is formed in the multi-layered insulating structure above the semiconductor substrate, and a trench is formed in the semiconductor substrate under the opening. Then, a groove is formed on an edge position of an intermediate layer of the multi-layered insulating structure by wet-etching the intermediate layer of the multi-layered insulating layer transversely using a pull back process. Then, a liner oxide layer is deposited on the groove and the trench. An oxide layer then fills the trench and the groove without generating voids or divots in the oxide layer of the trench.